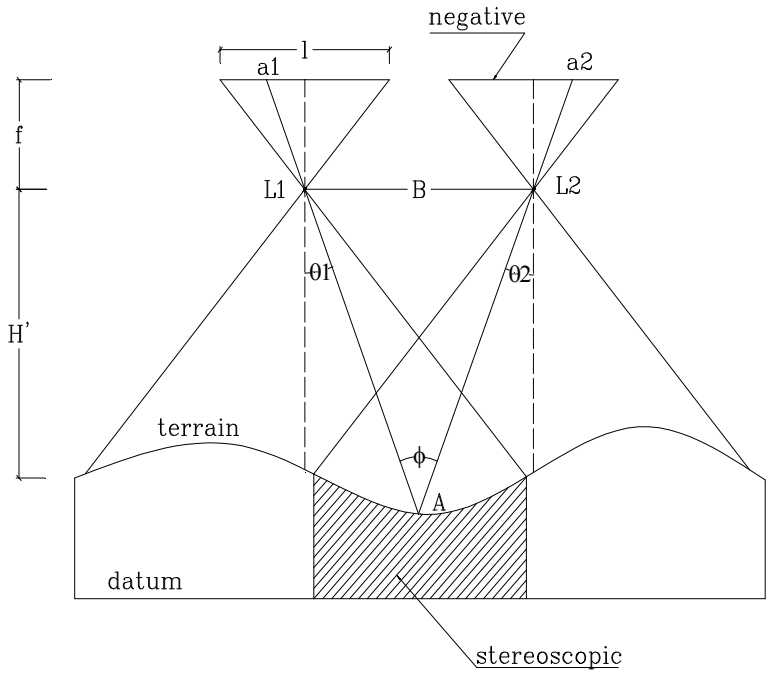
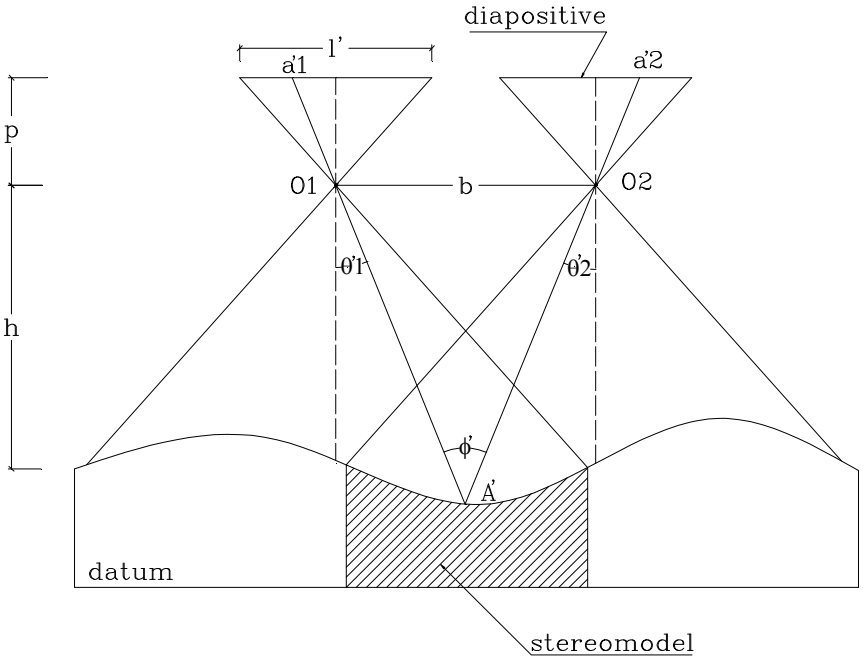
# Principal of photogrammetry

## *Aerial photogrammetry*




## *Stereo plotter instrument*



i- $Diapositive\ scale = \frac{p}{H'}$

ii- $Negative\ scale\ or\ scale\ of\ photo(vertical) = \frac{f}{H'}$

iii- $Diapositive/Negative = \frac{p}{f}$

iv- $Stereomodel\ scale = \frac{h}{H'}\ or\ \frac{b}{B}$

A stereopair was taken using standard camera from a flying height of 2000 m. If the positives were projected by a projector lens having its principal distance equal 160 mm from a vertical distance of 80 cm upward the plotting table, calculate:

I) The diapositive format.
II) The required ratio to achieve the interior orientation of the stereomodel.
III) The diapositive scale.
IV) The scale of the stereomodel.

***Solution***

f=150mm l=230mm p=160mm

H'=2000m h=80cm

i-

$$\frac{f}{p} = \frac{l}{l'}$$

$$l' = \frac{p\,l}{f} = \frac{160 * 230}{150} = 245.33mm = 9.6"$$

ii-

$$ratio = \frac{p}{f} = \frac{160}{150} = 1.067$$

iii-

$$diapositive\ scale = \frac{p}{H} = \frac{160/1000}{2000} = \frac{1}{12500}$$

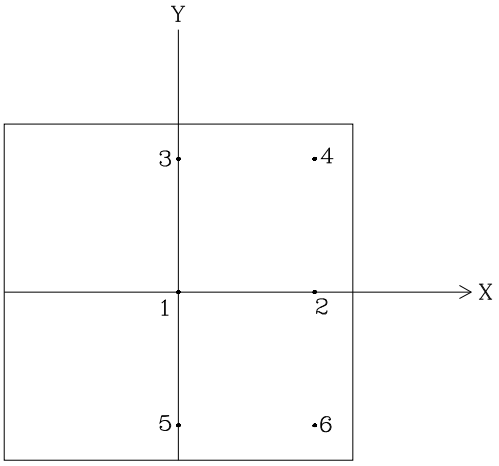
iv-

$$stereomodel\ scale = \frac{h}{H'} = \frac{80/100}{2000} = \frac{1}{2500}$$

# Notes

Coordinates of points:

1 (0,0) 2 (b,0)
3 (0,d) 4 (b,d)
5 (0,-d) 6 (b,-d)




| motion | effect | points |
|---|---|---|
| by | by | 1,2,3,4,5,6 |
| bz | $\frac{d}{h}\ bz$ | 3,4 |
| | $-\frac{d}{h}\ bz$ | 5,6 |
| χ | bχ | 2,4,6 |
| φ | $\frac{b.d}{h}\ \varphi$ | 4 |
| | $-\frac{b.d}{h}\ \varphi$ | 6 |
| ω | h ω | 1,2 |
| | $h\left(1+\frac{d^2}{h^2}\right)\omega$ | 3,4,5,6 |

| motion | effect | points |
|---|---|---|
| by | value | 1,2,3,4,5,6 |
| bz | value | 3,4 |
| | -value | 5,6 |
| χ | value | 2,4,6 |
| φ | value | 4 |
| | -value | 6 |

General equation:

$$P_4 + P_6 - 2P_2 = P_3 + P_5 - 2P_1$$

المعادله ديه لازم تتحقق ديماً ، وطبعاً لازم نعرف الرسومات بتاعت ال motions كلها.

1) If the effect of motion (bz) on Y-parallax at point (4) = -3 mm, then the Y parallaxes at the points of the stereomdels due to (bz) equal to:

| | | |
|---|---|---|
| $P_1$ = | $P_3$ = | $P_5$ = |
| $P_2$ = | $P_4$ = -3 mm | $P_6$ = |

Prove your answer graphically and mathematically.

***Solution***

<u>effect of bz</u>

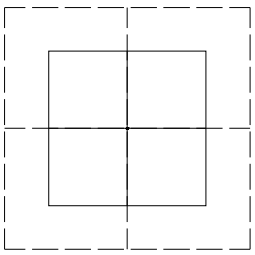
$$\Delta y = \frac{y}{z}\, bz$$

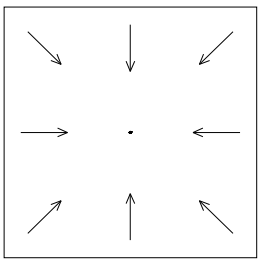
$$\Delta y = \frac{y}{h}\, bz$$

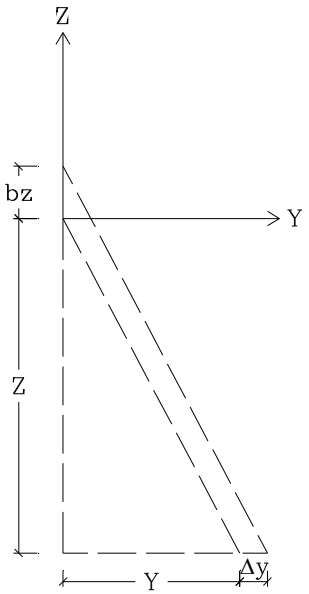
$$P1 = P2 = 0$$

$$P3 = P4 = \frac{d}{h}\, bz$$

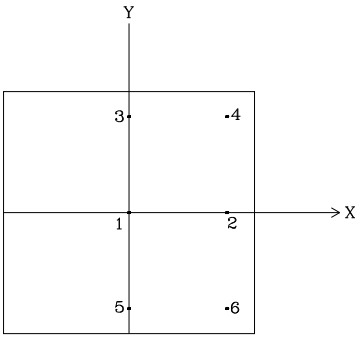
$$P5 = P6 = -\frac{d}{h}\, bz$$








| | | |
|---|---|---|
| P1=0 | P3= -3mm | P5= 3mm |
| P2=0 | P4= -3mm | P6= 3mm |



2) If the effect of motion (χ) on Y-parallax at point (2) = +4 mm, then the Y parallaxes at the points of the stereomdels due to (χ) equal to:

$P_1$ = $P_3$ = $P_5$ =
$P_2$ = +4 mm $P_4$ = $P_6$ =

Prove your answer graphically and mathematically.

***Solution***

effect of χ

$y' = xsin\mathcal{X} + ycos\mathcal{X}$

χ is small angle ⇒ sinχ=χ ; cosχ=1

$y' = x.\mathcal{X} + y$

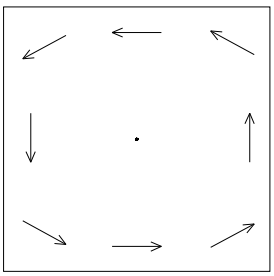
$y' - y = \Delta y = x.\mathcal{X}$

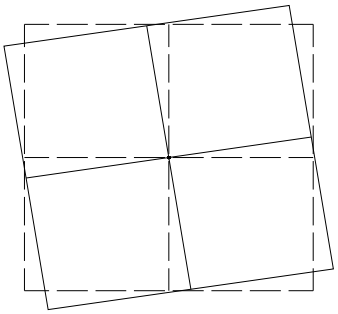
$P1 = P3 = P5 = 0$

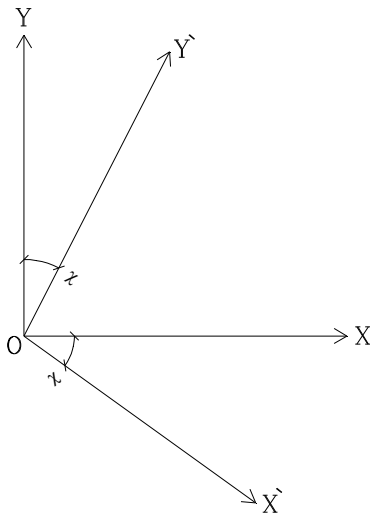
$P2 = P4 = P6 = b.\mathcal{X}$

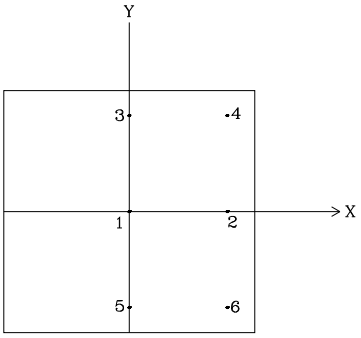
P1=0 P3= 0 P5= 0

P2=4mm P4=4mm P6=4mm







3) The effect of motion (ω) at points (1&……) of the stereomodel is similar to the effect of (…...) on the aerial photograph. It produces a (…….) of the X-axis equals to:
…… for the photo
and ……. for the stereomodel

4) The rotation motion (.....) around Y-axis produces the same effect of (…...) around X-axis but in a …….. direction.

5) The effect of motion (φ) at points (4&……) in Y-direction is similar to the effect of (…...) in X-direction of the stereomodel.

***Solution***

3) The effect of motion (ω) at points (1&2) of the stereomodel is similar to the effect of tilt (t) on the aerial photograph. It produces a translation of the X-axis equals to:
f tan(t) for the photo
and h tanω for the stereomodel

4) The rotation motion (φ) around Y-axis produces the same effect of (ω) around X-axis but in a perpendicular direction.

5) The effect of motion (φ) at points (4&6) in Y-direction is similar to the effect of (ω) in X-direction of the stereomodel.